

**THEREFORE WHAT IS CLAIMED IS:**

1. A method for synthesizing colloidal nanocrystals of periodic table groups IV-VI compounds with size-tunable electromagnetic emission, comprising the steps of;

a) forming a first solution by dissolving a compound containing a metal selected from group IV of the periodic table in a first effective solvent;

b) forming a second solution by dissolving a compound containing an element selected from group VI of the periodic table in a second effective solvent and mixing said second solution with said first solution to form a third solution;

c) agitating the third solution for a selected period of time under controlled heating to grow colloidal nanoparticles of a IV-VI compound of selected mean size, said effective solvent including ligands that stabilize said colloidal nanoparticles; and

d) isolating the colloidal nanoparticles of selected mean size.

2. The method according to claim 1 wherein said compound containing a metal selected from group IV of the periodic table contains lead (Pb).

3. The method according to claim 2 wherein said compound containing a metal selected from group IV of the periodic table is selected from the group consisting of lead acetate, lead acetylacetonate, lead nitrate, lead chloride, lead iodide, lead bromide, lead sulfate, lead tantalite, lead titanate and lead chromate.

4. The method according to claim 1 wherein said compound containing an element selected from group VI of the periodic table contains sulphur.
5. The method according to claim 4 wherein said compound containing sulphur is selected from the group consisting of bis(trimethylsilyl)sulfide, bis(trialkylsilyl)sulfide, elemental sulfur, dialkyl thioureas, thioacetamide, dimethylthioformamide, alkylthiols, alkyldisulfides and hydrogen sulfide; and wherein said second effective solvent is selected from the group consisting of trialkyl phosphine, n-alkyl amine, trialkyl amine, octadecene and oleic acid.
6. The method according to claim 1 wherein said compound containing a metal selected from group IV of the periodic table contains a metal selected from the group consisting of lead (Pb), tin (Sn) and germanium (Ge).
7. The method according to claim 1 wherein said effective solvent including ligands that stabilize said colloidal nanoparticles includes a fatty acid.
8. The method according to claim 1 wherein said step of isolating the colloidal nanoparticles of selected mean size includes addition of a polar solvent to said third solution, said polar solvent being selected from the group consisting of small alkyl chain alcohols, ethyl acetate, dimethylformamide, acetonitrile, that induces reversible aggregation of the colloidal nanoparticles and can then be separated from the supernatant solution and solvents.

9. The method according to claim 1 wherein said step of agitating the third solution for a selected period of time under controlled heating to grow colloidal nanoparticles is for long enough to grow colloidal particles in a range from about 1 nm mean diameter to about 10 nm mean diameter.
10. The method according to claim 1 wherein said effective temperature is in a range from about 30°C to about 350°C.
11. The method according to claim 1 wherein said second effective solvent is selected from the group consisting of trialkyl phosphine, n-alkyl amine, trialkyl amine, octadecene and oleic acid.
12. A method for synthesizing colloidal nanocrystals of PbS, comprising the steps of;
- a) forming a first solution by dissolving a compound containing lead (Pb) in an effective stabilizing solvent;
  - b) forming a second solution by dissolving a compound containing sulphur (S) in an effective solvent and mixing said second solution with said first solution to form a third solution;
  - c) stirring the third solution for a selected period of time under controlled heating to grow colloidal nanoparticles of PbS of selected mean size, said effective solvent including ligands that stabilize said PbS colloidal nanoparticles;
- and

d) isolating the colloidal PbS nanoparticles of selected mean size.

13. The method according to claim 12 wherein said compound containing lead is PbO, and wherein said effective stabilizing solvent is oleic acid.

14. The method according to claim 12 wherein said step of forming a second solution by dissolving a compound containing sulphur (S) in an effective solvent effective solvent includes dissolving bis(trimethylsilyl)sulfide in trioctylphosphine.

15. The method according to claim 12 wherein said compound containing lead (Pb) is selected from the group consisting of lead acetate, lead acetylacetonate, lead nitrate, lead chloride, lead iodide, lead bromide, lead sulfate, lead tantalite, lead titanate and lead chromate.